

REMARKS:

- 1) Referring first to the last sentence of section 8 on page 5 of the Office Action, I am fully conversant with the German language and have again studied German Patent Publication DE 195 23 301 A1 in detail. Nothing is mentioned in the entire reference regarding a "gas function layer". This German Patent Publication discloses a heating device for a "high temperature metal oxide sensor". Temperature measuring capabilities within the range of 600 to 1000°C are mentioned. This German Patent Publication has been discussed on page 6 of the present specification. Since the reference does not expressly disclose any gas function layer, applicants do not admit that the reference comprises such a gas function layer. However, if the Examiner should show, based on sound scientific principle, that such gas function layer is required for the proper operation of the heater device for a high temperature metal oxide sensor, then applicants will not object to such an interpretation of this reference because even if the reference should comprise such a gas function layer it would still not be relevant to the claimed invention as set forth in the above claims and as will be explained in further detail below.
- 2) The substantive clarifications in the independent claims 52, 61, 65 and 68 and the clarifications in the dependent claims 53, 54, 55, 56, 58, 59, 60, 62, 63, 64, 66 and 67 do not contain any new matter. Independent claim 57 has not been amended.

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- 3) The expression "side or surface" in claims 56, 58, 62 and 67 has been changed as set forth above to "surface" in order to avoid the interpretation appearing in section 3 on page 2 of the Office Action where a distinction is made between "one side - the middle side, with the heater secured to the opposite side - the outside.". Applicants' claim language is intended to cover one surface that faces, for example up when the gas sensor extends horizontally, while the opposite surface faces down when the gas sensor extends horizontally.
- 4) Referring to sections 1 and 2 on page 2 of the Office Action, the rejection of claims 65 to 68 under 35 USC §102(b) as being anticipated by US Patent 4,776,943 (Kitahara) is respectfully traversed for the following reasons. A single reference to be anticipatory must show each and every feature of the claim rejected as being anticipated. That requirement is not satisfied by Kitahara. The critical features of claim 65 comprise
1. at least one meandering heater path;
 2. said heater path including amplitudes forming heater sections;
 3. a first heater section has the largest amplitude;
 4. each heater section has a different heating resistance value;
 5. the different heating resistance value of each heater section depends on a spacing between the tip (10) and a respective heater section of said heater sections;
- and

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6. the second and further amplitudes forming the heater sections diminish toward the tip (10) relative to said first largest amplitude.

Features 3, 4, 5 and 6 are not present in Kitahara. For that fact alone, the disclosure of Kitahara cannot anticipate independent claim 65 and its dependent claims 66 and 67. For example all amplitudes of Kitahara's meandering heater section have the same size. Patent drawings are not drawn to scale. More importantly, Kitahara does not mention anything at all about meandering diminishing amplitudes in his heater (11). Therefore, each heater section of Kitahara's heater sections has the same resistance value. That fact alone negates anticipation.

- 5) More specifically, section 2 on page 2 of the Office Action asserts that according to Fig. 4 of Kitahara the meandering heater 11 of Kitahara "has some diminishing amplitudes toward the tip end". That position is not supported by the entire Kitahara disclosure much less by Fig. 4, nor by Fig. 10 of the Kitahara reference because Figs. 4 and 10 are perspective views so that the portion of meander amplitudes that extend in parallel to the short edge of the base plate (10, 40) in Figs. 4 and 10 of Kitahara, are seen at a different perspective angle than the heater portions extending from left to right (parallel to the longer edges) of the base plate in Figs. 4 or 10 of the Kitahara disclosure. Even more important, there is nothing whatsoever mentioned in the Kitahara disclosure regarding any feature that the second and further amplitudes of the heater sections diminish toward the tip in dependence on the spacing between the tip (10) and the respective heater section and relative to the first

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largest amplitude. Such features are not present in the Kitahara disclosure and reading these features into the Kitahara disclosure is based on the knowledge of the present invention. Therefore, Kitahara does not anticipate claims 65, 66 and 67.

6) The assertion regarding claim 67 that "14 is secured to one side of 12 with the heater secured to the opposite side" is respectfully traversed because Fig. 4 of Kitahara clearly shows that the heater 11 is secured to its own base plate 10 and not to the "atmospheric air receiving plate 12". Thus, the interpretation of Kitahara as set forth in section 2 on page 2 of the Office Action, is based on hindsight rather than on what Kitahara actually discloses. Neither diminishing of the meandering amplitudes toward the tip nor the resistance change depending on distance from the tip are disclosed by the Kitahara reference. This position is backed up by the lack of any description of these features in the Kitahara disclosure. It follows, that Kitahara does not disclose all the elements that are defined in present claim 65 and claims 66 and 67 dependent from claim 65. Therefore, Kitahara does not anticipate claims 65, 66 and 67.

7) On page 5, section 7 of the Office Action it is mentioned that the Examiner saw an allowable feature in "that each amplitude of said meandering heater diminishes toward said tip", (emphasis added). It is in fact not possible that each amplitude diminishes because there must be one first amplitude that is the largest amplitude relative to which the following amplitudes diminish in any group of heater sections. Thus, the first

amplitude is the reference amplitude. In fact, each following amplitude is the reference amplitude for the next following amplitude. More specifically, in present Fig. 4a there are two largest amplitudes positioned closest to the conductor portion of the sensor and furthest away from the tip. Only the second and following amplitudes in each group of amplitudes diminish toward the tip (10) relative to the respective first largest amplitude. This fact has now been clarified in claims 52, 65 and 68.

- 8) Claim 68 which covers all embodiments of the invention as shown in Figs. 4a, 5a and 6 to 10 defines further features that are also not found in Kitahara. For example the heater sections form at least two groups of heater sections and the amplitudes of each group of heater sections diminishes toward the tip (10) relative to one largest amplitude in each group of heater sections. The Office Action does not show that feature in the Kitahara disclosure nor in any other reference. Therefore, claim 68 is not anticipated.
- 9) For example, each of Figs. 5a and 6 to 10 shows four groups of amplitudes, two in the top meander and two in the lower meander. Each group has a largest amplitude relative to which each following amplitude of that group diminishes toward the tip. Claim 68 has been further clarified in this respect. Neither Kitahara nor any other reference of record shows such an amplitude structure. Withdrawal of the rejection of claims 65 to 68 under 35 USC §102(b) in view of Kitahara is respectfully requested.

- 10) Referring to section 3 on page 2 of the Office Action, the rejection of claims 65, 66 and 68 under 35 USC §102(b) as being anticipated by US Patent 4,654,624 (Hagan et al.) is respectfully traversed for the following reasons. Contrary to the assertion that "Hagan discloses the claimed invention at the sole Figure, with gas function layer 13 supported by sensor carrier 3, and meandering heater (14) having diminishing amplitudes toward the tip end". The semiconductor sensors 2 and 3 of Hagan are supported on one side of the substrate (1). The heater conductor paths (14, 15) are supported on the same side of the substrate (1) in the Hagan disclosure. The substrate (1) carries two identical semiconductor sensors (2) and (3). The heater amplitudes (14) extending crosswise from left to right in each of the semiconductor sensors (2) and (3) of Hagan et al. have a uniform amplitude of equal size. The heater amplitudes (15) extending parallel to the longitudinal edges of the substrate (1) and toward the tip of the substrate (1) also have a uniform amplitude except that towards the tip the amplitudes (15) increase rather than diminish. The amplitude size, near the tip increases in Hagan et al. It is therefore not understood how increasing amplitudes can anticipate diminishing amplitudes.
- 11) From section 3 on page 2 of the Office Action it is further not clear whether claim 67 is part of this group of claims because section 3 refers to claim 57. It is assumed that claim 67 is intended. Claim 67 has been clarified in that the gas function layer according to the invention is attached to one surface of the substrate while the heater is attached to the opposite

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surface of the substrate. Therefore, the interpretation appearing in section 3 on page 2 of the Office Action referring to different sides on the same side cannot be applied to amended claim 67.

- 12) As stated above and with further regard to present claim 67, avoiding the term "side" in this claim obviates the "side" interpretations of section 3, on page 2 of the Office Action. In Hagan et al. the interdigitating sensor electrodes (12) and (13) are surrounded by the heater electrodes (14) and (15) on the same surface of the substrate. Therefore, it is respectfully submitted that the disclosure of the Hagan et al. reference does not meet the definition of present claim 67 that calls expressly for positioning the sensor gas function layer on one surface near the tip of the substrate while the heater is attached to the opposite surface of the substrate near the tip.
- 13) US Patent 4,654,624 (Hagan et al.) discloses expressly in col. 2, lines 48 and 49 that the heating conductors are meandering and intertwined. No further disclosure is provided by Hagan et al. regarding the construction and characteristics of the heater sections, particularly with regard to the resistance that depends on the distance of the particular heater section or amplitude from the tip of the sensor. Neither Hagan et al. nor Kitahara taken singly or in combination disclose, much less suggest, the above listed features including the formation of at least two groups of heater sections and the teaching that the amplitudes forming each group of the heater sections diminish toward the tip relative to a largest amplitude within each group. Withdrawal

of the rejection of claims 65, 66, 67 and 68 under 35 USC §102(b) in view of Hagan et al. is respectfully requested.

- 14) Referring to section 5 starting at the top of page 3 of the Office Action, the rejection of claims 52 to 56 and 65 to 68 under 35 USC §103(a) in view of German Patent Publication DE 195 23 301 taken in the light of Kitahara is respectfully traversed. The assertion that the German Patent Publication DE 195 23 301 "discloses the claimed invention" is not supported by this German reference. Fig. 1 of the German Patent Publication shows that the two heater sections, each of which is designated by the reference character (H), have each a U-shaped configuration. The smaller, inner U-configuration is nested within the somewhat larger, outer U-configuration. The two heater sections (H) are clearly connected in parallel to each other. On page 2, starting in line 12, it is said that the resistance $R(\vartheta)$ of the heater structure (8) depends as a square function from the temperature (δ) and is calculated as:

$$R(\vartheta) = \frac{U(\vartheta)}{IH}$$

whereby the current (IH) through the resistances (RM1) and (RM2) of the measuring conductors (ML1) or (ML2) are negligibly small because the measuring of the voltage $U(\vartheta)$ takes place at a high ohmic value. Thus, the core of the German disclosure is the parallel connection of the two heater sections (H), regardless of how many series connected heater sections are seen at the top of page 4 of the Office Action.

15) It is expressly admitted in lines 3 and 4 on page 3 of the Office Action that the German Patent Publication does not show any meander section, nor the location of the contact points, nor the gas function layer, nor the diminishing amplitudes nor the varying width. With these five features missing in the primary reference German Patent Publication DE 195 23 301 in mind, it is respectfully submitted that Kitahara cannot supply these missing elements because Kitahara also does not show nor suggest these features in combination. This is so even if the meandering three sections of the heating conductor with uniform amplitudes of Kitahara are used in the German Patent Publication as apparently suggested in the Office Action. The claimed invention would not result from such a combination much less would it be suggested by such a combination. More specifically, claim 52 as amended recites that the two meandering heater paths (6A) and (6B) are interconnected by an intermediate non-meandering heater portion (6C). Further, there is no suggestion in either of these references that the amplitudes, except a first largest amplitude of the meandering heater path are diminishing in their size from the conductor carrier section toward the tip relative to the first largest amplitude. Conventionally it was assumed, at the time the invention was made, that a uniform heating of the sensor is accomplished by surrounding the sensor with the heater, see for example Hagan et al. where the heaters (14, 15) surround the interdigitated sensor electrodes (12 and 13). Such a conventional teaching shows that those skilled in this art at the time the invention was made did not realize that the largest heat dissipation is not at the tip but near the conductor carrier section. Thus, the interpretation of Kitahara as it appears in

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the Office Action is not based on the prior art knowledge but on the knowledge of the invention.

- 16) Further, the two heater sections (H) in the German Patent Publication are approximately of the same length, except for the sections running in parallel to the tip of the sensor. The heater sections (H) also have the same width all along their length. Therefore, the two heater sections (H) in the German reference have substantially the same resistances and certainly not resistances that are diminishing the closer a particular heater portion is located to the tip. Assuming that the tip in the sensor according to the German reference is positioned at the right-hand end of Fig. 1 of this reference, there is certainly no disclosure, much less a suggestion that the heater sections diminish toward the tip. Nothing whatsoever to that effect is mentioned nor suggested in the German reference. Moreover, since the two heater sections (H) are connected in parallel, it does not matter which resistance in the parallel connection is smaller or larger. The effective resistance in the equivalent circuit of Fig. 2 resulting from the parallel connection of the German reference is the resistance $R(\vartheta)$. Any perceived series connections seen in the German disclosure do not alter the fact that the heater sections (H) are connected in parallel in the German reference. Since the meandering heater (11) of Kitahara does not have any diminishing amplitudes as specifically defined in present claim 52, using the heater (11) of Kitahara in the German reference would not result in the claimed invention, much less would it suggest the claimed invention.

- 17) Heating the gas function layer so that it will have a substantially uniform temperature or a minimal temperature gradient throughout the gas function layer has been a desirable goal. Please see the background information part of the present specification. However, achieving that goal has escaped those skilled in the art prior to the present invention. Therefore, allocating the features of the claimed invention to items in the references which, based on sound scientific principle cannot possibly have these features, is in error. Under 35 U.S.C. §103(a) the examination must be of the "whole" claim.
- 18) The rejection of present claims 54, 56 and 67 and 54, 61, 62 on page 3, lines 9 to 11 of the Office Action is respectfully traversed. The Office Action asserts that "the gas function layer meets claims 54, 56, 67...". The Office Action further asserts "the contact point of DE '301, for claims 54, 61-62, would be under same since the function layer of Kitahara is all along the device." Such statements are evidence of a piecemeal examination. It follows that these claims are not being examined "as a whole". According to the invention the gas function layer (4) is secured to the sensor carrier portion next to the tip (10) and therefore is not "all along the device". How a gas function layer that is "all along the device" could suggest a gas function layer position next to the tip has not been explained in the Office Action. Further, Kitahara's heater is secured to its own support (10) and not the substrate that carries the function layer. Therefore, using a gas function layer in the German Patent Publication "all along the device" does not suggest the

claimed combination of features in present claims 54, 56, 61, 62 and 67.

- 19) With regard to the repeated rejection of claims 52, 65 and 68 in the lower half of page 3 of the Office Action, it cannot be emphasized often enough that Fig. 4 of Kitahara definitely does not show any variation in the amplitudes depending on the spacing from the tip, more specifically, toward the tip. "Toward the tip" is not the equivalent of "along the tip". The Examiner's interpretation of the Kitahara disclosure which does not mention any diminishing of amplitudes whatsoever in the written text, is based on the knowledge of the present invention and such interpretation is reversible error. The Kitahara amplitudes clearly do not diminish toward the tip and therefore cannot suggest the features of present claims 52, 65 and 68 as set forth on page 3 of the Office Action. Without admitting that Kitahara discloses differently sized amplitudes, let us assume just for the sake of argument that Kitahara shows two sizes of heater amplitudes. In that case it might appear perspectively, that the larger sized heater amplitudes extend parallel to the long edges of the support while the smaller sized heater amplitudes extend parallel to the short edge of the support. How such assumed features of the Kitahara heater amplitudes could be interpreted as "diminishing toward the tip" is not understood.
- 20) It is also not clear on what basis the Office Action asserts that some of the different heater sections of Kitahara have different widths if such is not recognizable much less expressly said in the Kitahara disclosure. The heater (11) in Kitahara is merely

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a single wavering line, the width of which does not change at all. Nothing is said in this respect in the Kitahara disclosure. Certainly, the width of the heater sections (H) in the German Reference are uniform along the entire length of these heater sections. Therefore, all rejections based on 35 USC §103(a) in view of Kitahara and the German Reference or vice versa are respectfully traversed. Withdrawal of the obviousness rejection of claims 52 to 56 and 65 to 68 is respectfully requested.

- 21) With regard to the sentence bridging pages 3 and 4 of the Office Action, it is agreed, that the power supply conductors (RH1) and (RH2) are connected in series with the parallel connection of the heaters (H) forming the heating structure in the German reference. Viewing Fig. 1 of the German reference '301, it is clear that the power supply conductors (HL1 and HL2) for supplying power to the heater structure (H) are several times wider than the resistor paths that form the heater structure (H). It follows that the supply conductors have a small resistance that is negligible. Hence, listing the resistances of the power supply conductors as a series part of the heater resistors is not relevant to the fact that the two heater portions (H) are electrically connected in parallel to each other. Further, the German reference does not disclose any temperature distribution toward the tip, much less a temperature distribution such that the temperature gradient throughout the function layer is substantially constant. Therefore, combining Kitahara with the German reference or vice versa does not provide any suggestion to a person of ordinary skill in the art at the time the invention was made how the features of the invention claimed as

a whole are to be assembled based on these two references without hindsight. Even more important, using Kitahara's heater (11) in '301 as contemplated in the Office Action does not result in the claimed invention and hence does not suggest the claimed invention as a whole..

22) With regard to claim 52, not a single reference shows a gas sensor in which the heater has different resistance values from section to section such, that these different resistance values depend on a spacing of the particular heater section from the tip of the sensor carrier section. These different resistance values result in generating varying amounts of heat for compensating varying amounts of heat dissipations. Not a single reference mentions anything regarding this correlation of the heat generation with the varying heat dissipations to achieve the required compensation of the heat dissipation for a uniform heating of the gas function layer. Further, not one of the applied references shows, much less suggests, that two meandering heater paths are interconnected at the tip by a non-meandering heater path. There is no teaching in any of the references that the second and further amplitudes are diminishing in their size toward the tip relative to the largest amplitude, wherein the diminishing depends on the spacing between the particular heater section or amplitude from the tip. Such a combination of features is not suggested by any of the reference combinations applied in the Office Action.

23) The rejection of claims 57 to 64 under 35 USC §103(a) on page 4 of the Office Action as being unpatentable over the above

mentioned German Patent Publication '301 taken in the light of Kojima et al. (US Patent 5,895,591) is respectfully traversed. Independent claim 57 is maintained unchanged. Independent claim 61 has been amended to the effect that the heater portion (6C) is a nonmeandering heater portion and connects the meandering heater paths (6A, 6B) in series with each other. In order to avoid repeating the remarks regarding the German Patent Publication 195 23 301, reference is made to the above discussion of this primary reference. Claim 57 comprises, among other features, the following features.

- a) The heater sections have different heating resistance values which depend on a spacing between any particular heater section and the tip of the sensor carrier section.
- b) The different heating resistance values generate varying amounts of heat for compensating varying heat dissipations.
- c) The heater path has a path length along the individual heater sections and a path width (b) so that the path length and the path width both vary, depending on the spacing between any particular heater section and the tip (10).
- d) Further, the path length diminishes from heater section to heater section toward the tip while the path width (b) increases from heater section to heater section toward the tip.

Claim 57 comprises further features in addition to the above listed features. All features must be examined "as a whole" in accordance with 35 USC §103(a). There is no disclosure whatsoever in the German Patent Publication that the two resistance sections (H) have different heating resistance values

to generate different quantities of heat for compensating differing quantities of heat dissipation. The two heater sections (H) of the German reference do not show any varying heater path widths. Rather, the width of the heater sections (H) in the German reference are constant from the supply conductors to the tip and along the tip which is considered to be the narrow edge of the substrate. It is self-evident from Fig. 1 of the German reference that the two legs of the U-configurations that extend in parallel to the narrow edge of the substrate in the German reference increase toward the tip, rather than decrease. More specifically, the outer U-leg parallel to the narrow edge is longer than the inner U-leg parallel to the narrow edge. Hence the second length increases toward the tip rather than diminish.

- 24) With regard to US Patent 5,895,591 (Kojima et al.), applicants do not deny that a heater section length of 5mm is larger than a heater section length of 3mm as shown in Fig. 8A of Kojima et al. However, Fig. 8A also shows that the length of the heater sections does not diminish toward the tip because the length of the heater section next to the base is 5mm and so is the length of the heater section next to the tip. Therefore, there is no diminishing of the length of the individual heater sections from the base side to the tip side. The same applies to the heater path width (b) because the width of the heater section, the 3mm section, next to the base is constant and therefore there is no width increase from section to section toward the tip. The 3mm heater section extending parallel to and along the tip has the widest width, but that width is constant along the tip and

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therefore does not increase from section to section toward the tip. The increase of the width of the right hand heater section and of the left hand heater section in Fig. 8A of Kojima et al., does not suggest an increase from section to section toward the tip. Therefore, even if the U-configurations of the heater of Kojima et al. are used to replace the U-configurations of the heater (H) in the German reference, the claimed invention and its function would not result. Withdrawal of the rejection of claim 57 and claims 58, 59 and 60 depending from claim 57 is respectfully requested.

- 25) Figs. 3 and 6 of Kojima et al. specifically applied against claim 57, show that the heater sections are thicker along the tip and thinner away from the tip. In Fig. 6 of Kojima et al. the width actually gets thinner toward the tip (Fig. 6 at 32), while it is constant along the tip, namely parallel to (33). Therefore, the Examiner's interpretation is not understood. In Fig. 6, the width of the last two heater sections (32), which are connected to the heater section parallel to the tip (33), are getting thinner toward the tip. Therefore, the Examiner reads the disclosure of Kojima et al. in the light of the present disclosure and not on the basis of what Kojima et al. show in fact. The Examiner's reference to the Abstract of Kojima et al. also shows a misinterpretation of the Kojima et al. reference. The relevant Abstract portion states expressly:

"Specifically, the wire width is made greater in the tip side subsection 25a than in the base side subsection 25b so that the resistance per unit length is lower in the tip side subsection 25a. The thus-designed heater section 25 produces a less amount of

heat in the tip side subsection than in the base side subsection, and this distribution of heat generation can reduce the possibility of cracks and breaking of a wire".

Kojima et al. teach generating a lesser amount of heat in the tip section and a higher amount of heat in the base section. How such a teaching is supposed to suggest the increase of the heater conductor width (b) from heater section to heater section toward the tip is not explained in the Office Action. Fig. 5 of Kojima et al. has been applied against present claim 61. The heater portions (s) at the tip of the meandering heater in Fig. 5 of Kojima et al. are clearly part of the same meander and hence there is no nonmeandering heater portion that interconnects two meandering heater paths in series.

26) Further, the reference to Fig. 15 misinterprets what is actually shown in Fig. 15 of Kojima et al. Reference is made to the last paragraph in col. 11 and the first paragraph in col. 12 of Kojima et al.. It is clear that the heater (52) is sandwiched between two U-shaped alumina layers (54) and (55). Therefore, it is not understood how the Examiner can allege that the gas sensor layer (57) is attached to the opposite side of the substrate (55) from heater (63) in Fig. 15 of Kojima et al. The zirconia substrate (57) in fact carries two sensor layers (61B) on one side and (61A) on the opposite side. Withdrawal of this interpretation of Fig. 15 of Kojima et al. is respectfully requested.

27) Claims 58 to 60 and 64 taken "as a whole" include more features than that "the connections would be under same". Please see the above remarks regarding the "whole layer 57" in Fig. 15 of Kojima

- 27) Claims 58 to 60 and 64 taken "as a whole" include more features than that "the connections would be under same". Please see the above remarks regarding the "whole layer 57" in Fig. 15 of Kojima et al. Therefore, the features of claims 58 to 60 and 64 taken as a whole are neither shown nor suggested by Kojima et al. if taken in combination with the German reference '301.
- 28) Similar considerations apply to the allegations regarding Fig. 18a at the bottom of page 4 of the Office Action. Please see col. 1, lines 16 to 25 of the Kojima et al. disclosure. The construction of Figs. 18a and 18b of Kojima et al. do not resemble anything claimed in present claims 58 and 62. This is so, because claims 58 and 62 make it clear that the sensor is attached to one surface while the heater is attached to the opposite surface of the same carrier or substrate. No such structure is disclosed in the Kojima et al. reference including Fig. 18a.
- 29) The Examiner's remarks in section 7 on page 5 of the Office Action have been addressed above.
- 30) With regard to section 8, line 6, on page 5 of the Office Action, claim 57 repeats verbatim the language of claim 38 that was indicated to be allowable. Claim 57 also includes the features of claims 32 and 37. Neither claim 32, nor claim 37, nor claim 38 includes any reference to "meandering". Yet, claim 57 describes the same concept but with different words. Therefore, it is not understood why it is alleged that claim 57 does not contain "all limitations" of claims 32, 37 and 38.

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31) Withdrawal of all rejections under 35 USC 102(b) and 103(a) is respectfully requested. Favorable reconsideration and allowance of the application, including all present claims 52 to 68 as amended are respectfully requested.

Respectfully submitted,

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Applicant

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